

SOME GUIDELINES FOR MANAGEMENT OF THE BLACK-FOOTED FERRET

Tim W. Clark

ABSTRACT.—Management guidelines are specified for monitoring and protecting the Meeteetse black-footed ferret (*Mustela nigripes*) population and habitat and for dealing with a series of special management considerations. The Meeteetse ferret population and habitat status are summarized as background. An annual management schedule is outlined, including methods and sources of existing baseline data with which to compare future results. The public support and organizational arrangements needed for successful overall management and recovery of the species are briefly discussed.

This paper outlines some management guidelines for the Meeteetse, Wyoming, black-footed ferret (BFF) population and its habitat. It can serve as a framework for management of other populations, if any can be located or established from Meeteetse BFF stock via captive breeding/translocation. Initially, study plans for the Meeteetse BFFs specifically called for development of management guidelines (Clark 1981, 1984a, b, Black-footed Ferret Recovery Team 1978). These guidelines specify directions for monitoring and protecting the BFF population and its habitat and for meeting certain management considerations. Furthermore, they can focus future discussion by land and wildlife managers as more specific management needs are identified.

BACKGROUND

These management guidelines are based on growing information about BFFs and their chief prey, prairie dogs (*Cynomys* sp.). An annotated BFF bibliography by Casey et al. (1986) lists 351 references, including study results on the Meeteetse BFFs through mid-1985. An earlier summary of BFF biology given by Henderson et al. (1969) and Hillman and Clark (1980) included results of the South Dakota studies (1964–1974). Several prairie dog bibliographies exist: Clark (1971) listed 225 references, Hassien (1973) listed 437, and Clark (in manuscript) lists about 200 citations from 1973 through 1985. History of the Mee-

teetse BFFs and their environment is given by Clark et al. (*Description and history*, 1986), and BFF habitat use patterns are given by Forrest et al. (*Black-footed ferret habitat*, 1985).

MANAGEMENT GUIDELINES

The Meeteetse BFF population was discovered in late September 1981 (Clark and Campbell 1981), and substantial baseline data now exist after 3.5 years of intensive study. Many BFF study methods have been developed and refined and many management needs identified for the population, its habitat, and a series of special considerations.

The Ferret Population

The status of the Meeteetse BFF population is summarized in Table 1. Collectively, field observations from 1981 to 1985 suggest that the BFF population is reproductive, stable, or increasing. It appears to be producing young in excess of number needed to sustain itself. But even an informal risk assessment of the BFF population and its habitat status requires that initial conclusions about the population be evaluated more critically. For example, initial estimates of minimum viable population (MVP) sizes of BFFs, based on conservative genetic estimates, indicate that the Meeteetse BFFs are below numbers recommended for even short-term population viability (estimate that 200 BFF's are needed, whereas 1984 counts showed only 43 adults

¹Department of Biological Sciences, Idaho State University, Pocatello, Idaho 83209, and Biota Research and Consulting, Inc., Box 2705, Jackson, Wyoming 83001.

TABLE 1. Status of the Meeteetse black-footed ferret populations (1981-1984).

Parameter	Status			Source
Size (July-August) ¹	1982	1983	1984	Clark 1983, 1984b, 1985a
	61	88	129	
Distribution	BFFs found in a 333 sq km area containing 37 white-tailed prairie dog colonies; total colony area 2,995 ha			Clark et al. <i>Description and history</i> , 1986; Forrest et al. <i>Black-footed ferret habitat</i> , 1985
Density	Mean 1 adult/56.6 ha; prairie dog colonies over 100 ha contain 2 or more BFFs year-round			Forrest et al. <i>Black-footed ferret habitat</i> , 1985
Age and sex structure:	1982	1983	1984	Clark 1983, 1984b; Forrest et al. 1984
Adults/young	21/40	28/60	43/86	
Replacement index	1.90	2.14	2.00 ²	
Female/male:				
Adult	—	—	20/9 ³	
Young	—	—	23/29	
Totals	—	—	43/38	
Natality	1982	1983	1984	Clark 1983, 1985; Forrest et al. 1984; Forrest et al.
No. litters	12	18	25	<i>Black-footed ferret habitat</i> , 1985
No. young	40	60	86	
Young/litter	3.33	3.33	3.44	
Mortality	Estimated 55%-75% of total population disappears annually			Forrest et al. <i>Life history characteristics</i> , 1985
Immigration/emigration	Unknown, but 15 cases show a mean of 2.5 km			Forrest et al. <i>Black-footed ferret habitat</i> , 1985

¹Minimum counts based on spotlighting surveys (1982 and 1983 counts are believed to be less than actual numbers).

²Replacement index = no. young divided by no. adults.

³Includes 4 adults (2F and 2M) for 1983.

present; Groves and Clark 1986). Computer simulations of demographic and environmental stochasticity, which may be more important than genetic considerations, are expected to show a MVP different from the 200 estimate. A population target for recovery must be based on a thorough examination of MVP.

This management scheme for the Meeteetse BFF population proposes three monitoring activities: (1) spotlight counts in summer, (2) capture-mark/recapture in fall, and (3) snow tracking and sign searches in winter. The techniques for each monitoring activity, expected data products, and sources of existing baseline data are described in Table 2. Plans of action for protection from (1) harassment, (2) diseases, and (3) predators/competitors are also outlined (Table 2).

The Ferret Habitat

The status of BFF habitat at Meeteetse is summarized in Table 3. Because prairie dog colonies compose BFF habitat (Linder et al. 1972; Clark et al. *Description and history*, 1986; Clark et al. *Descriptive ethology*, 1986; Forrest et al. *Black-footed ferret habitat*, 1985; Houston et al. 1986), BFF habitat management focuses on monitoring and protecting prairie dogs. White-tailed prairie dogs (*C. leucurus*) and the small mammals that

live in their burrows serve as food for BFFs (Campbell et al., unpublished data), and prairie dog tunnels are used for shelter and litter rearing by BFFs. White-tailed prairie dog ethology and ecology have been described by Clark, Hoffman, and Nadler (1971) and Clark (1977). Black-tailed prairie dogs (*C. ludovicianus*) have been described by King (1955), Koford (1958), Hoogland (1981). Gunnison's prairie dogs (*C. gunnisoni*) have been described by Fitzgerald and Lechleitner (1974).

BFF habitat management includes four monitoring activities: (1) recording prairie dog emergence and breeding in late winter, (2) determining prairie dog reproductive success in late spring, (3) mapping active and inactive prairie dog colonies in the region each fall, and (4) surveying alternative prey populations in late summer/early fall. The techniques for each monitoring activity, expected data products, and sources of existing baseline data are described in Table 4. Protection from (1) drastically altered land uses, (2) vegetative alteration, and (3) prairie dog poisoning and shooting are also called for.

Specific Considerations

A host of special considerations surrounding the Meeteetse BFFs require attention, including multiple land use precedents and mandates,

TABLE 2. An outline of annual monitoring and protection management needed for the Meeteetse black-footed ferret population.

I. MONITORING

A. USE SPOTLIGHT TECHNIQUES

1. Season: Summer, 5 July–30 August
2. Baseline data sources: Basic spotlight methods described by Clark et al. (*Handbook of methods*, 1984), Campbell et al. (1985)
3. Management parameters:
 - a. Determine litter numbers, distribution, and sizes (results of 1982–1984 litter surveys given in Table 1 with primary data sources)
 - b. Check litter behavior and development (some behavioral data in Clark et al. [*Descriptive ethology*, 1986])
 - c. Determine minimum population numbers (results of 1982–1984 estimates in Table 1 with primary data sources)

B. USE CAPTURE/MARK/RECAPTURE TECHNIQUES

1. Season: Fall, 1 August–15 October
2. Baseline data sources: Basic capture, handling, and marking methods described by Thorne et al. (1985), Fagerstone et al. (1985), Forrest et al. (1984); results of 1982–1984 surveys shown in Table 1 with primary data sources
3. Management parameters:
 - a. Estimate population size
 - b. Determine age and sex structure
 - c. Determine measurements and body weights
 - d. Sample ectoparasites
 - e. Determine inter- and intracolony dispersal and movements
 - f. Take other data from captured animals

C. USE SNOWTRACKING AND SIGN SEARCHES

1. Season: Winter, 1 December–1 April
2. Baseline data sources: Basic snowtracking and sign search methods described in Clark et al. (*Handbook of methods*, 1984; Clark et al. *Seasonality of black-footed ferret diggings*, 1984; Clark et al. *Descriptive ethology*, 1986), and Richardson et al. (1986) results also in these sources
3. Management parameters:
 - a. Determine minimum numbers
 - b. Determine distribution
 - c. Quantify movements
 - d. Quantify hunting behavior
 - e. Sample intra- and intercolony movements
 - f. Estimate onset of breeding

II. PROTECTION

A. ASCERTAIN LEVELS OF HUMAN ACTIVITIES

1. Problem: Harassment
2. Baseline data sources: Use levels should be managed as necessary to approximate pre-1980 activities, yet allow for needed conservation research; general discussions of research impacts by Clark (1981), Clark et al. (*Handbook of methods*, 1984), and Groves and Clark (1986); Campbell et al. (1985) described spotlight effects on BFFs
3. Management parameters:
 - a. Facilitate site visits by conservation biologists, landowners, and others

- b. Limit research impacts
- c. Limit tourists, media, sightseer visits
- d. Monitor traditional land uses

B. MONITOR DISEASES USING STANDARD RECOGNIZED TECHNIQUES

1. Problem: Diseases, parasites, disorders
2. Baseline data sources: Thorne 1984, U.S. Public Health Service, local veterinarians, ranchers
3. Management parameters (Thorne 1984):
 - a. Sylvatic plague
 - b. Canine distemper
 - c. Rabies
 - d. Pseudotuberculosis
 - e. Leptospirosis
 - f. Botulism
 - g. Staphylococcosis
 - h. Tuberculosis
 - i. Streptococcosis
 - j. Mange
 - k. Ear mites
 - l. Ring worms
 - m. Ticks
 - n. Fleas
 - o. Human influenza
 - p. Others

C. USE STANDARD MONITORING TECHNIQUES FOR PREDATORS AND COMPETITORS (observation, scent stations, live trapping, nesting checks, mark/recapture, radiotelemetry, etc.)

1. Problem: Predators/competitors
 - a. Avian—owls, hawks, eagles
 - b. Mammalian—long-tailed weasels, skunks, badgers, bobcats, coyotes
2. Baseline data sources: B. Phillips (unpublished data) on raptor populations in the BFF area
3. Management parameters:
 - a. Estimate predator/competitor populations
 - b. Estimate effects of predators and competitors on BFFs

oil/gas development, hunting/trapping, livestock grazing, road and fence construction, catastrophes (e.g., diseases), cooperation of the local public and ranchers, and private/state/federal interorganizational arrangements needed to monitor and protect BFFs and their habitat.

MULTIPLE LAND USES.—The Meeteetse BFFs occupy an area managed under various state, federal, and private multiple land use philosophies and mandates. Many traditional land uses (e.g., livestock grazing) are compatible with BFFs. The extent to which each land use can enhance or harm BFFs must be examined from a comprehensive, analytical, “cumulative effects” viewpoint (e.g., see U.S. Forest Service et al. 1985). A model predicting cumulative effects should be developed, constantly updated, and used to inform all management decisions.

TABLE 3. Status of the Meeteetse black-footed ferret habitat (1981–1985).

Parameter	Status	Source
Location	Park Co., western Big Horn Basin, Wyoming	Clark 1985a; Clark et al. <i>Description and history</i> , 1986; Forrest et al. <i>Black-footed ferret habitat</i> , 1985
Geology/Soils	Dominated by Absaroka volcanics, soils shallow (1 m), well drained and clay-loam, derived from shale parent materials	Clark et al. <i>Description and history</i> , 1986
Topography	Broad flat plains at foot of Carter Mountain dissected by creeks, elevation 1890 m	Clark et al. <i>Description and history</i> , 1986
Climate	Ranges from 40.5 C to -43.3 C, 173 days each year below 0 C, winds estimated average 13–16 kph, snow usually less than 10 cm accumulation, precipitation averages 30 cm per year	
Vegetation	Junegrass (<i>Koeleria cristata</i>) and sagebrush (<i>Artemisia tridentata</i>)	Collins and Lichvar 1986
Prairie dog colonies	37 colonies exist in the ferret area, total 2995 ha, mean 80.9 ha (\pm 217.2 ha, range 0.5–1307.0)	Clark et al. <i>Description and history</i> , 1986
Prey	Analysis of 86 scats showed 87% prairie dogs	Campbell et al. in ms.; Clark et al. <i>Descriptive ethology</i> , 1986; Powell et al. 1985
Ownership:		Clark et al. <i>Description and history</i> , 1986
Surface	<u>Private</u> 35.6% <u>State</u> 31.0% <u>Federal</u> 33.4%	
Subsurface	12.0% 31.0% 57.0%	
Potential conflicts	Oil/gas full field development, some development has already occurred	Clark et al. <i>Description and history</i> , 1986

A "zone" management plan can facilitate management decisions: (1) Zone I is the BFF-occupied prairie dog complex and a 1.2 km buffer zone, (2) Zone II is the nearby unoccupied prairie dog colonies, and (3) Zone III is the remaining prairie dog colonies in the Big Horn Basin. The BFF zone management plan and cumulative effects analysis could be patterned after the Yellowstone grizzly bear and the northern Rocky Mountain wolf habitat management plans and cumulative analysis models (U.S. Forest Service 1979, U.S. Forest Service et al. 1985, Northern Rocky Mountain Wolf Recovery Team 1985). The Montana Bureau of Land Management (BLM < n.d. > 1982) devised a habitat management plan for the prairie dog ecosystem, and the Wyoming Bureau of Land Management, Cody Resource Area (in preparation) is preparing a similar plan for the Big Horn Basin. These plans can serve as background for a management team to produce more specific and protective plans for the Meeteetse BFFs. Hubbard and Schmitt (1985) listed several recommendations for conserving prairie dogs, including (1) conserve prairie dogs statewide, (2) detour impacts around prairie dog colonies, (3) protect prairie dogs against plague, and (4) apply single use management (i.e., conserve prairie dogs) to key areas.

OIL/GAS EXPLORATION AND EXTRACTION.—The Meeteetse region contains several oil/gas fields (Clark et al. *Description and history*, 1986), and geophysical exploration has been conducted throughout the Meeteetse BFF area on numerous occasions since the early 1950s. Oil/gas exploration and extraction could have detrimental effects on BFFs by destroying prairie dogs and prairie dog habitat and by directly harming BFFs (U.S. Fish and Wildlife Service 1982). The two common oil/gas exploratory techniques are vibroseis, which uses large truck-mounted vibrating devices to generate shock waves, and explosive charges, which are detonated on or below the surface. These shock waves may affect prairie dogs and BFFs by collapsing tunnel systems, causing auditory impairment, disrupting social systems, or other mechanisms. U.S. Fish and Wildlife Service (1982) proposed study of seismic activities, and such studies are now underway (George Menkens, personal communication).

Extraction of oil/gas may affect BFFs and their habitat detrimentally. Full field development would be most detrimental. Among the potential problems are (1) pad construction and well operation will reduce BFF habitat, (2) leakages and spills could kill BFFs and eliminate habitat, (3) increased vehicle traffic may result in road-

TABLE 4. A management outline for annual monitoring and protection of the Meeteetse black-footed ferret habitat.

I. MONITORING

- A. Make visual counts of prairie dog numbers and distribution
 1. Season: Spring, 5 May–5 June
 2. Baseline data sources: Clark et al. (*Descriptive ethology*, 1986), Fagerstone (1986)
 3. Management parameters:
 - a. Determine total numbers, age structure, aboveground litter sizes, and distributions
 - b. Check litter behavior and development (Clark 1977)
 - c. Estimate biomass
- B. Remap extent of prairie dog burrow mounds throughout the area, noting areas of active/inactive colonies
 1. Season: Fall, August–September
 2. Baseline data sources: Clark et al. (*Description and history*, 1986), Forrest et al. (*Life history characteristics*, 1985)
 3. Management parameters:
 - a. Determine total increase or decrease in prairie dog colonies
 - b. Determine the cause of increase or decrease
- C. Note prairie dog emergence times and onset of reproductive activities, quantify prairie dog breeding numbers and distribution
 1. Season: Winter, February–March
 2. Baseline data sources: Clark et al. (unpublished data), Clark (1977)
 3. Management parameters:
 - a. Direct observation
 - b. Sampling

II. PROTECTION

- A. LAND USE INSTABILITY
 1. Season: Annually
 2. Baseline data sources: Clark et al. *Description and history*, 1986
 3. Management parameters:
 - a. Map land use patterns
 - b. Determine history of land use patterns
- B. VEGETATIVE INSTABILITY
 1. Season: Annually
 2. Baseline data sources: Collins and Lichvar 1986
 3. Management parameters:
 - a. Map plant communities
 - b. Monitor dynamics of plant communities
 - c. Monitor livestock interactions
- C. FIRES
 1. Season: Annually
 2. Baseline data sources: Fire history unknown
 3. Management parameters:
 - a. Determine fire history
 - b. Develop fire prevention strategy
- D. PRAIRIE DOG POISONING AND SHOOTING
 1. Season: Annually
 2. Baseline data sources: Clark et al. 1985, Fagerstone 1986
 3. Management parameters:
 - a. Determine history
 - b. Prohibit or limit poisoning and shooting

killed BFFs, (4) increased human presence may significantly increase the potential for BFF mortality via diseases (e.g., canine-borne diseases) and BFF spatial displacement, and (5) overhead power poles will serve as raptor perching sites, thereby increasing the raptor population and their hunting effectiveness.

Many management options exist to avoid the harmful effects of these oil/gas related actions on BFFs—lease trades and extensions by the federal and state regulatory agencies, directional drilling, burying power lines underground, restricting times of human activities to midday, and other techniques should all be considered as means to eliminate detrimental impacts on the BFFs and their habitat.

BIG GAME HUNTING/TRAPPING.—Big game hunting (i. e., pronghorn, *Antilocapra americana*) has occurred each fall in the BFF-occupied area for many decades. Historic hunting levels have been compatible with BFFs and have been closely monitored by ranchers. Trapping with steel jaw traps for coyotes (*Canis latrans*), badgers (*Taxidea taxus*), skunks (*Mephitis mephitis*), and mink (*Mustela vison*) is not compatible in BFF-occupied areas.

LIVESTOCK GRAZING.—Domestic livestock alter range vegetation and affect the myriad plants and animals of the grassland ecosystem “more extensively, rapidly, and profoundly than any other of man’s range management activities” (Autenrieth 1983:24). Grazing of the Meeteetse rangelands favors the continued existence of prairie dogs, and therefore BFFs. If rangelands were overstocked by domestic livestock so that prairie dogs were in immediate and direct competition with livestock, the BFF population would be expected to suffer.

ROADS/FENCES.—Roads and fences can affect BFFs directly and indirectly. Additional roads along with uncontrolled access may increase the probability of BFF road-kills. Fences and high gate posts increase raptor perching sites and may thereby expose BFFs to increased predation. Roads and fence construction should be kept to a minimum. However, in the area of existing oil wells and sludge discharge pits, ferret-proof fences could ensure that BFFs would not fall into a pit full of lethal petroleum waste products.

CATASTROPHES.—Specific plans to meet potentially catastrophic events (e.g., sylvatic plague outbreak) should include the worse case option to live capture all the remaining Meeteetse BFFs and either translocate and/or take them into captivity. A network of cooperative research institutions, zoos, and other facilities needs to be established and readied to receive BFFs on very short notice. This presupposes that adequate monitoring procedures are in place to detect catastrophic events as early in their eruption as possible.

LOCAL PUBLIC AND RANCHERS.—Most BFF conservation actions must be carried out with the consent and cooperation of private landowners. The western Big Horn Basin of Wyoming, the area occupied by the BFFs, consists of many relatively large ranches, many established in the 1870s-1880s. A sensitive conservation program must encompass landowner rights and values. Flath and Clark (1984) described an approach that guides the program in Montana to locate and recover BFFs. Frequent contacts in an informal setting with ranchers to discuss potential problems has been important in guiding management directions (Clark 1984a, b). A respect for property rights and a landowner role in the pace and direction of conservation is essential.

ORGANIZATIONAL ARRANGEMENTS.—Several organizational interests are focused on the Meeteetse BFFs—private, national, and international conservation groups, universities, and an array of state and federal agencies (Clark 1984b). Even though all parties seek BFF conservation and recovery, there are great differences in interest, contributions, plans, and methods to save the BFFs, etc. This fact was noted by Bogan (1985:28.1), who said, "The first [need for the Meeteetse BFFs] is the reconstitution of an advisory board to oversee black-footed ferret research and management. Such a board would include more researchers than at present and would be more inclusive in its consideration of research and management of ferrets." Because the design of coalitions of organizations (e.g., formal organizational arrangements permitting or precluding integration and coordination, joint decision making and goal setting) greatly affects the coalition's performance, it is essential that the coalition surrounding the BFF be congruently arranged (i.e., matched) to en-

hance BFF recovery (Nadler and Tushman 1980). The broad design characteristics for such a program and the rationale behind them were given by Clark (1985b). Briefly, program overview should be structured along flexible, "organic" rather than rigid, "mechanistic or bureaucratic" principles (Hrebiniak 1978) because organic organizations are best able to meet the inherent high uncertainty characteristic of the BFF program. Decision-making processes should be open and more formal to avoid the "group think" trap whereby an organization prematurely seeks closure on ideas and discussion of the range of options available to recover and manage a species (Janis 1972). Furthermore, program management must be consistent with the Endangered Species Act and various state laws.

DISCUSSION

Many more options existed historically to manage BFFs than exist today. Because only a single extant population is known, an energetic proactive management program is needed to ensure their conservation and eventual full recovery. These management guidelines outline actions to monitor and protect the Meeteetse BFF population, its habitat, and some special considerations. They are not exhaustive in terms of detail. As other BFF populations are found or established, these guidelines can serve to manage them, too. However, a specific management plan will be needed for each new population. The primary value of general management guidelines, like these for BFFs, is found in the discussion they may stimulate about the basic requirements and problems needed for successful species management (Autenrieth 1983). As our understanding of BFFs increases, the management guidelines given here may require modification and refinement.

Another BFF management requirement not addressed above needs mention. Specific captive breeding/reintroduction plans need to be developed, as called for in 1978 (Black-footed Ferret Recovery Team) and again in 1982 (Clark 1984a), following direction discussed by Richardson et al. (in press), Forrest et al. (*Black-footed ferret habitat*, 1985), and Houston et al. (1986). Potential translocation sites are under evaluation in Montana (J.

Cada, personal communication), Utah (R. Haysanyagaer, personal communication), New Mexico (J. Hubbard, personal communication), and Wyoming (Collins 1985, B. Miller, personal communication). Cooperative planning will allow for a "timely," well organized captive breeding/translocation effort.

There is a risk that the Meeteetse BFFs could become extinct at any time. The extinction risk (as well as the direction and pace of BFF recovery) is difficult to assess because of uncertainties surrounding the BFFs. "Risk" means simply exposure to a danger and is often defined to include the concept of the likelihood (i. e., probability) of damage (Westman 1985). It is strongly recommended that a formal risk assessment be made of both the probability that the Meeteetse BFFs may become extinct and the overall management strategy needed for full species recovery. A meeting involving all the private, state, and federal interests could conduct the needed analysis. Behan and Vaupel (1982) offer procedures to conduct such a risk assessment. These management guidelines, the minimum viable population estimates by Groves and Clark (1986), and the cumulative effects analysis called for are all forms of risk assessment models and could serve, in part, as background for the more formal risk assessment called for here.

Conservation of the Meeteetse BFF population and its habitat as described in this management outline focused almost exclusively on the biological challenge, but it did mention two parallel challenges—sociological and organizational. Essential to conservation of the BFFs is successfully meeting the sociological and organizational challenges simultaneously with the biological challenge.

ACKNOWLEDGMENTS

Many people aided in this effort and foremost among them are my colleagues Louise Richardson, Steve Forrest, Denise Casey, and Tom Campbell. The Meeteetse area ranchers and the land and wildlife managers in the state and federal agencies also provided significant support and information for this paper. Wildlife Preservation Trust International, New York Zoological Society, World

Wildlife Fund—U.S., Chicago Zoological Society, and the National Geographic Society financially supported this work. D. Casey, L. Richardson, S. Forrest, Ron Crete of U.S. Fish and Wildlife Service, Dennis Flath and John Cada of Montana Fish, Wildlife, and Parks, and Tom Enright of the Bureau of Land Management reviewed the manuscript, and their helpful suggestions are appreciated.

LITERATURE CITED

- AUTENREITH, R., ed., 1983. Guidelines for the management of pronghorn antelope. Texas Parks Wildl. Dept., Austin. 51 pp.
- BEHAN, R. D., AND J. W. VAUPEL. 1982. Quick analysis for busy decision makers. Basic Books, Inc., New York. 415 pp.
- BLACK-FOOTED FERRET RECOVERY TEAM. 1978. Black-footed ferret recovery plan. Region 6, Denver, Colorado. 150 pp.
- BOGAN, M. A. 1985. Needs and direction for future black-footed ferret research. Pages 28.1–28.5 in S. Anderson and D. Inkle, eds., Black-footed Ferret Workshop Proc., Laramie, Wyoming, September 18–19, 1984. Wyoming Game and Fish Publ., Cheyenne.
- BUREAU OF LAND MANAGEMENT. No date. Habitat management plan: prairie dog ecosystem. Draft. Montana State Office, Billings. 61 pp.
- . 1982. Black-tailed prairie dogs: Control/management in Phillips Resource Area. Programmatic Envir. Assessment, Lewistown District, Montana. 90 pp.
- . 1985. Prairie dog ecosystem habitat management plan. Draft. Cody Resource Area, Wyoming. 49 pp.
- CAMPBELL, T. M. III, D. E. BIGGINS, S. C. FORREST, AND T. W. CLARK. 1985. Spotlighting as a method to locate and study black-footed ferrets. Pages 24.1–24.7 in S. Anderson and D. Inkle, eds., Black-footed Ferret Workshop Proc., Laramie, Wyoming, September 18–19, 1984. Wyoming Game and Fish Publ., Cheyenne.
- CAMPBELL, T. M. III, T. W. CLARK, L. RICHARDSON, AND S. C. FORREST. Unpublished manuscript. Food habits of Wyoming black-footed ferrets.
- CASEY, D. E., J. DUWALDT, AND T. W. CLARK. 1986. Annotated bibliography of the black-footed ferret. Great Basin Nat. Mem. 8:185–208.
- CLARK, T. W. 1971. Literature concerning prairie dogs. Wyoming Range Manage. 286:29–44.
- . 1977. Ecology and ethology of the white-tailed prairie dog (*Cynomys leucurus*). Milwaukee Publ. Mus., Pubs. in Biol. and Geol. No. 3. 97 pp.
- . 1981. A proposal for a research grant in support of the Meeteetse black-footed ferret conservation studies: for the period 15 February 1982–14 February 1983 (12 months). 95 pp.
- . 1983. Last of the black-footed ferrets? National Geographic 163:828–838.

- . 1984a. Strategies in endangered species conservation: a research view of the ongoing black-footed ferret conservation studies. Pages 145–154 in Symposium on Issues in Technology and Management of Impacted Western Wildlife, Thorne Ecological Institute, Boulder, Colorado. November 1982.
- . 1984b. Biological, sociological, and organizational challenges to endangered species conservation: the black-footed ferret case. Human Dimensions in Wildl. Newsl. 3:10–15.
- . 1985a. The Meeteetse black-footed ferret conservation studies. Nat. Geog. Res. (Spring) 1985: 299–302.
- . 1985b. Organizing for endangered species recovery. Paper presented at Northwest Sec., The Wildlife Soc., Sheraton Hotel, Missoula, Montana, April 2–5, 1985.
- CLARK, T. W., R. S. HOFFMANN, AND C. F. NADLER. 1971. *Cynomys leucurus*. Mammalian Species No. 7. 4 pp.
- CLARK, T. W., AND T. M. CAMPBELL III. 1981. Additional black-footed ferret (*Mustela nigripes*) reports from Wyoming. Great Basin Nat. 41:461–464.
- CLARK, T. W., T. M. CAMPBELL III, M. H. SCHROEDER, AND L. RICHARDSON. 1984. Handbook of methods for locating black-footed ferrets. Wyoming Bur. Land Manage., Wildl. Tech. Bull. No. 1. 55 pp.
- CLARK, T. W., L. RICHARDSON, D. CASEY, T. M. CAMPBELL III, AND S. C. FORREST. 1984. Seasonality of black-footed ferret diggings and prairie dog burrow plugging. J. Wildl. Manage. 48:1441–1444.
- CLARK, T. W., L. RICHARDSON, S. C. FORREST, T. M. CAMPBELL III, D. E. CASEY, AND K. A. FAGERSTONE. 1985. Black-footed ferret prey base. Pages 7.1–7.14 in S. Anderson and D. Inkley, eds., Black-footed Ferret Workshop Proc., Laramie, Wyoming, September 18–19, 1984. Wyoming Game and Fish Publ., Cheyenne.
- CLARK, T. W., S. C. FORREST, L. RICHARDSON, D. CASEY, AND T. M. CAMPBELL III. 1986. Description and history of the Meeteetse black-footed ferret environment. Great Basin Nat. Mem. 8:72–84.
- CLARK, T. W., L. RICHARDSON, S. C. FORREST, D. CASEY, AND T. M. CAMPBELL III. 1986. Descriptive ethology and activity patterns of black-footed ferrets. Great Basin Nat. Mem. 8:115–134.
- COLLINS, E. I., ed., 1985. Wyoming natural area needs workshop proceedings. The Nature Conservancy, Arlington, Virginia. 166 pp.
- COLLINS, E. I., AND R. W. LICHTVAR. 1986. Vegetation inventory of current and historic black-footed ferret habitat in Wyoming. Great Basin Nat. Mem. 8:85–93.
- FAGERSTONE, K. A. 1986. Comparison of capture-recapture and visual count indices of prairie dog densities in black-footed ferret habitat. Great Basin Nat. Mem. 8:94–98.
- FAGERSTONE, K. A., D. E. BIGGINS, AND T. M. CAMPBELL III. 1985. Marking and radiotagging of black-footed ferrets (*Mustela nigripes*). Pages 10.1–10.10 in S. Anderson and D. Inkley, eds., Black-footed Ferret Workshop Proc., Laramie, Wyoming, September 18–19, 1984. Wyoming Game and Fish Publ., Cheyenne.
- FITZGERALD, J. P., AND R. R. LECHLEITNER. 1974. Observations on the biology of Gunnison's prairie dog in central Colorado. Amer. Midl. Nat. 92:146–163.
- FLATH, D. L., AND T. W. CLARK. 1984. Montana: crucial key to ferret recovery. Mont. Outdoors, May/June: 34–37.
- FORREST, S. C., L. RICHARDSON, T. W. CLARK, AND T. M. CAMPBELL III. 1984. Litter survey and mark/recapture of black-footed ferrets at Meeteetse, July–October 1984. Unpublished report, 15 Feb. 1985. 14 pp.
- FORREST, S. C., T. W. CLARK, L. RICHARDSON, AND T. M. CAMPBELL III. 1985. Black-footed ferret habitat: some management and reintroduction considerations. Wyoming Bur. Land Mgmt., Wildl. Tech. Bull. No. 2. Cheyenne. 49 pp.
- FORREST, S. C., T. W. CLARK, L. RICHARDSON, D. E. BIGGINS, K. A. FAGERSTONE, AND T. M. CAMPBELL III. 1985. Life history characteristics of the genus *Mustela*, with special reference to the black-footed ferret, *Mustela nigripes*. Pages 23.1–23.14 in S. Anderson and D. Inkley, eds., Black-footed Ferret Workshop Proc., Laramie, Wyoming, September 18–19, 1984. Wyoming Game and Fish Publ., Cheyenne.
- GROVES, C. R., AND T. W. CLARK. 1986. Determining minimum population size for recovery of the black-footed ferret. Great Basin Nat. Mem. 8:150–159.
- HASSIEN, F. D. 1973. Prairie dogs: a partial bibliography. Pages 178–205 in R. L. Linder and C. N. Hillman, eds., Proc. Black-footed Ferret and Prairie Dog Workshop, South Dakota State University, Brookings.
- HENDERSON, F. R., R. F. SPRINGER, AND R. ADRIAN. 1969. The black-footed in South Dakota. South Dakota Dept. Game, Fish and Parks Tech. Bull. 4: 1–37.
- HILLMAN, C. N., AND T. W. CLARK. 1980. *Mustela nigripes*. Mammal. Species No. 126. 3 pp.
- HOOGLAND, J. L. 1981. The evolution of coloniality in white-tailed and black-tailed prairie dogs (Sciuridae: *Cynomys leucurus* and *C. ludovicianus*). Ecology 62:252–272.
- HOUSTON, B. R., T. W. CLARK, AND S. C. MINTA. 1986. Habitat suitability index model for the black-footed ferret: a method to locate transplant sites. Great Basin Nat. Mem. 8:99–114.
- HEBENIAK, L. G. 1978. Complex organizations. West Publ. Co., New York. 402 pp.
- HUBBARD, J. P., AND C. G. SCHMITT. 1984. The black-footed ferret in New Mexico. Final Rept. to Bur. Land Manage., Sante Fe, New Mexico. 118 pp.
- JANIS, I. L. 1972. Victims of groupthink. Houghton Mifflin Co., Boston. 225 pp.
- KING, J. A. 1955. Social behavior, social organization, and population dynamics in a black-tailed prairie dog colony in the Black Hills of South Dakota. University of Michigan Contrib. Lab. Vert. Biol. 67:1–123.
- KOFORD, C. B. 1958. Prairie dogs, white faces, and blue grama. Wildl. Monogr. 3:1–78.
- NADLER, D. A., AND M. L. TUSHMAN. 1980. A model for diagnosing organizational behavior. Organizational Dynamics, Autumn: 35–51.

- LINDER, R. L., R. B. DAHLGREN, AND C. N. HILLMAN. 1972. Black-footed ferret-prairie dog interrelationships. Symposium on rare and endangered wildlife of the southwestern U. S. New Mexico Dept. Game and Fish, Santa Fe.
- NORTHERN ROCKY MOUNTAIN WOLF RECOVERY TEAM. 1985. Northern Rocky Mountain wolf recovery plan. Draft. U.S. Fish Wildl. Serv., Missoula, Montana. 67 pp.
- POWELL, R. A., T. W. CLARK, L. RICHARDSON, AND S. C. FORREST. 1985. Black-footed ferret (*Mustela nigripes*) energy expenditure and prey requirements. Biol. Conserv. 34:1-15.
- RICHARDSON, L., T. W. CLARK, S. C. FORREST, AND T. M. CAMPBELL III. 1985. Snowtracking as a method to search for and study the black-footed ferret. Pages 25.1-25.11 in S. Anderson and D. Inkley, eds., Black-footed Ferret Workshop Proc., Laramie, Wyoming, September 18-19, 1984. Wyoming Game and Fish Publ., Cheyenne.
- _____. 1986. Black-footed ferret recovery: a discussion of some options and considerations. Great Basin Nat. Mem. 8:169-184.
- _____. In press. Winter ecology of black-footed ferret (*Mustela nigripes*) in Meeteetse, Wyoming. Amer. Midl. Nat.
- THORNE, T. 1984. Doctoring the black-footed ferret. Wyoming Wildl. March:11-19.
- THORNE, T., M. H. SCHROEDER, S. C. FORREST, T. M. CAMPBELL III, L. RICHARDSON, D. BIGGINS, L. R. HANEBURY, D. BELITSKY, AND E. S. WILLIAMS. 1985. Capture, immobilization, and care of black-footed ferrets for research. Pages 9.1-9.8 in S. Anderson and D. Inkley, eds., Black-footed Ferret Workshop Proc., Laramie, Wyoming, September 18-19, 1984. Wyoming Game and Fish Publ., Cheyenne.
- U.S. FISH AND WILDLIFE SERVICE. 1982. Biological opinion on the effects of proposed oil and gas related activities on black-footed ferrets near Meeteetse, Wyoming (6-1-82-F-012). Helena Montana Endangered Species Field Office, 4 Oct. 1982. 8 pp.
- U.S. FOREST SERVICE. 1979. Guidelines for management involving grizzly bears in the greater Yellowstone area. Reg. 2, Missoula, Montana. 136 pp.
- U.S. FOREST SERVICE/NATIONAL PARK SERVICE/INTER-AGENCY GRIZZLY BEAR STUDY TEAM. 1985. Cumulative effects assessment process for the Yellowstone Ecosystem. Grizzly Bear Habitat Symp., 30 Apr.-2 May 1985, Missoula, Montana.
- WESTMAN, W. E. 1985. Ecology, impact assessment, and environmental planning. Wiley-Interscience Publ., New York. 532 pp.